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COMMUNICATION

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Shraddha Prabhakar Karikar, Subhash Vitthal Mali, Kulkarni Prasad & Aphale Priti

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AN ASSESSMENT OF BIRD COMMUNITIES ACROSS UJJANI AND ITS FIVE SATELLITE WETLANDS IN SOLAPUR DISTRICT OF MAHARASHTRA, INDIA

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Abstract: Ujjani wetland is a potential Ramsar site in Maharashtra, India with several satellite wetlands associated with it. The present study contributes to single large or several small habitat conservation theories by assessing wetland bird communities. Aquatic bird communities were assessed using area search and point count methods at Kumbhargaoon (Ujjani), Bhadalwadi, Madanwadi, Palasdev, Pimple and Ravangaon wetlands between October 2011 and September 2012. These are representative satellite wetlands around Ujjani. One-hundred-and-ten species of wetland birds across 12 orders and 29 families were recorded. Out of these, 66 were resident and 44 were found to be migrants. These birds represent 23% mudflat feeder, 16% upland feeder, 14% marsh feeder, 12% bird of prey, 11% surface feeder and fish eaters, while divers and wet meadow feeders were represented with 8.5% and 5% of the species, respectively. Among the birds recorded, Woolly-necked Stork *Ciconia episcopus*, Common Pochard *Aythya farina*, and Greater Spotted Eagle *Clanga clanga* belong to the Vulnerable category; while Eurasian Curlew *Numenius arquata*, Oriental Darter *Anhinga melanogaster*, Black-tailed Godwit *Limosa limosa*, Black-headed Ibis *Threskiornis melanocephalus*, Lesser Flamingo *Phoeniconaias minor*, Painted Stork *Mycteria leucocephala*, River Tern *Sterna aurantia*, and Great Thick-knee *Esacus recurvirostris* represent Near Threatened category on the IUCN Red List. The presence of these bird species underlines the importance and conservation priorities of a major as well as smaller satellite wetlands. Anthropogenic activities such as cattle grazing, fishing, sand and soil mining, land encroachment, urban development and tourism were observed as some of the threats to this wetland ecosystem as well as bird communities.

Keywords: Aquatic birds, Ramsar site, SLOSS, wetland bird communities.

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Author contribution: SPK—contributed in research idea development and its implementation on field, sample collection and analysis. SVM—contributed in designing of experiments and provided critical remarks on manuscript. PAK—provided inputs for deciding study area and sampling sites. Also contributed in technical aspects for wetland mapping. PVA—contributed in wetland ecosystem monitoring, field data collection and identification of bird species.

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INTRODUCTION

Wetlands are distinct zones intermediate between terrestrial and aquatic ecosystem where the water table is usually at or near the surface of the land and is covered by shallow water (Semeniuk & Semeniuk 1995). Wetlands are the most productive ecosystems in the world (Mitsch et al. 2009). Natural and man-made reservoirs form small heterogeneous water patches in their vicinity. Such small wetlands associated with large streams are called satellite wetlands (Bedford 1996; Novitski et al. 1996; Patten et al. 2008).

Wetlands maintain the health of the environment and support a rich biodiversity. They complete habitat requirements of various water birds. Birds are excellent indicators of wetland health (Kumar & Gupta 2013). Habitat protection is important to conserve bird communities associated with it.

Large wetlands normally receive all the importance while smaller and isolated wetlands receive least attention and are often neglected from conservation priorities. Many studies have focused on major and larger wetlands while very few scientific investigations have been undertaken on comparatively small, isolated and not so well-known wetlands. In the absence of such studies, smaller and isolated wetlands are neglected from appearing in conservation priorities even if they are located in the vicinity of a major wetland.

On a theoretical conservation perspective, single large or several small (SLOSS) habitats debate is well known; many ecologists argue for one large habitat while an equal number of scientists advocate for many small habitats (Ma et al. 2010). It was argued that species richness increases with habitat area and hence larger block of habitat would support more species than any of the smaller blocks. Further, Simberloff & Abele (1976) contested that if the smaller protected area had unshared species, then it is possible that two smaller reserves could have more species than a single large reserve.

Before we take any stand on such perspectives, it is primarily required to initiate studies that compares a large wetland and many smaller ones. Such studies can help in deciding conservation priorities in fragmented habitats. In this context, the present study explores the status of bird communities harboured at one large wetland and several small satellite wetlands associated with it. Ujjani wetland and its satellite wetlands were assessed for this work.

The Ujjani Dam is an earthen-cum-masonry gravity dam located on river Bhima. The Bhima River is a

tributary of river Krishna that originates in the ranges of the Western Ghats. This dam is amongst the largest dams in Maharashtra, situated near Ujjani Village of Solapur District. The dam was primarily built for irrigating water-scarce fields. It is located at 18.299°N & 74.763°E, 465m. This region is a plain expanse with negligible slope and the reservoir is spread across 348 km² (Mahabal et al. 2011). It has more of shallow areas at the fringe parts of the reservoir, that provide a distinctive habitat for the avifauna. The Ujjani wetland is a potential Ramsar site in Maharashtra (Samant 2002; Islam & Rahmani 2008).

MATERIAL AND METHODS

Study area

The Ujjani wetland has a huge expanse and to overcome practical difficulty in sampling, Kumbhargaoon (18.266°N & 74.805°E, 494m), a representative location of Ujjani wetland was selected for sampling as it covers very shallow to very deep-water areas. As Ujjani wetland is dam backwater, similar type of five man-made satellite wetlands, viz., Bhadalwadi (18.234°N & 74.781°E, 511m), Madanwadi (18.285°N & 74.707°E, 515m), Ravangaon (18.330°N & 74.613°E, 556m), Pimple (18.247°N & 74.729°E, 516m), and Palasdev (18.211°N & 74.865°E, 507m) associated with Ujjani wetland was selected for the present study. In order to know the exact location of these wetlands, satellite imagery was superimposed on the toposheet. A map of these sites was prepared to indicate relative locations of these wetlands with respect to Ujjani with the help of QGIS 2.18 (Image 1).

Bird survey

The study was conducted between October 2011 and September 2012. Counts were conducted near the wetland where all or most of the surface area and edge were visible (Bibby et al. 2000). The survey duration includes the time required to thoroughly scan a wetland. Sampling was conducted using area search and point count method. Point counts were taken for areas where visibility is obstructed like marshy area and upland vegetation. No two-point counts were taken within a distance of 200m. Care was taken to ensure that birds were recorded only once (Bibby et al. 2000, Weller 1999). Area search methods were used for areas with clear visibility like open water. The accessible edges of wetlands were walked around to detect any unseen birds. The birds were observed during the peak hours of their activity from sunrise to 10.00h and 16.00–18.00



Image 1. Ujjani and its satellite Wetlands (Source: Google Image 2011).

h using Olympus (8 x 40 mm, 10 x 50 mm) binoculars. Identification of birds was done using field guides (Ali & Ripley 1995; Grimmett et al. 2013), and only those species with confirmed identity were recorded and reported.

Data classification and analysis

Recording and listing of these birds were done using standard common and scientific names (Praveen et al. 2016). Residential status of the birds as resident and migrants had been assigned with reference to the study area on the basis of presence or absence method. The status of the recorded bird species was established on the basis of frequency of sightings (Kumar & Gupta 2009) as Abundant (A) recorded 9–10 times out of 10 visits, Common (C) recorded 7–8 times out of 10 visits, Frequent (F) recorded 5–6 times out of 10 visits, Occasional (O) recorded 3–5 times out of 10 visits, Rare(R) recorded 0–2 times out of 10 visits (Therivel & Morris 1995).

Birds were delineated in eight feeding categories as bird of prey, fish eaters, divers, mudflat feeder, marsh feeder, wet meadow, surface feeder ducks, and upland feeders (Gole 1993).

To compare wetlands, a cluster analysis was performed on the presence of bird communities. Cluster analysis was performed using Jaccard's similarity

measure and a paired group method by PAST 3 software (Field & McFarlane 1968; Day & Edelsbrunner 1984; Washington 1984; Hartzell et al. 2007). The conservation status of the observed species was listed using the IUCN Red List, 2016 ver3.1 (IUCN 2016).

RESULTS AND DISCUSSION

One-hundred-and-ten species of wetland bird genera belonging to 12 orders and 29 families were recorded from Kumbhargao (Ujjani) and its satellite wetlands between October 2011–September 2012.

The checklist of birds observed, identified and recorded in the region along with their family and resident status is provided in Table 1. It was observed that Anatidae (16 species) followed by Scolopacidae (14 species) were the most represented families of the study area (Figure 1); whereas, Anhingidae, Dicruridae, Falconidae, Gruidae, Meropidae, Pandionidae, Podicipedidae, Recurvirostridae, and Rostratulidae were represented by just a single genus and least represented.

Among the recorded species 66 species were resident and 44 migratory. Relative abundance studies revealed that six species were abundant, 21 species were common, 46 species were frequent, 25 occasional and 12 were rare. Woolly-necked Stork *Ciconia episcopus*,

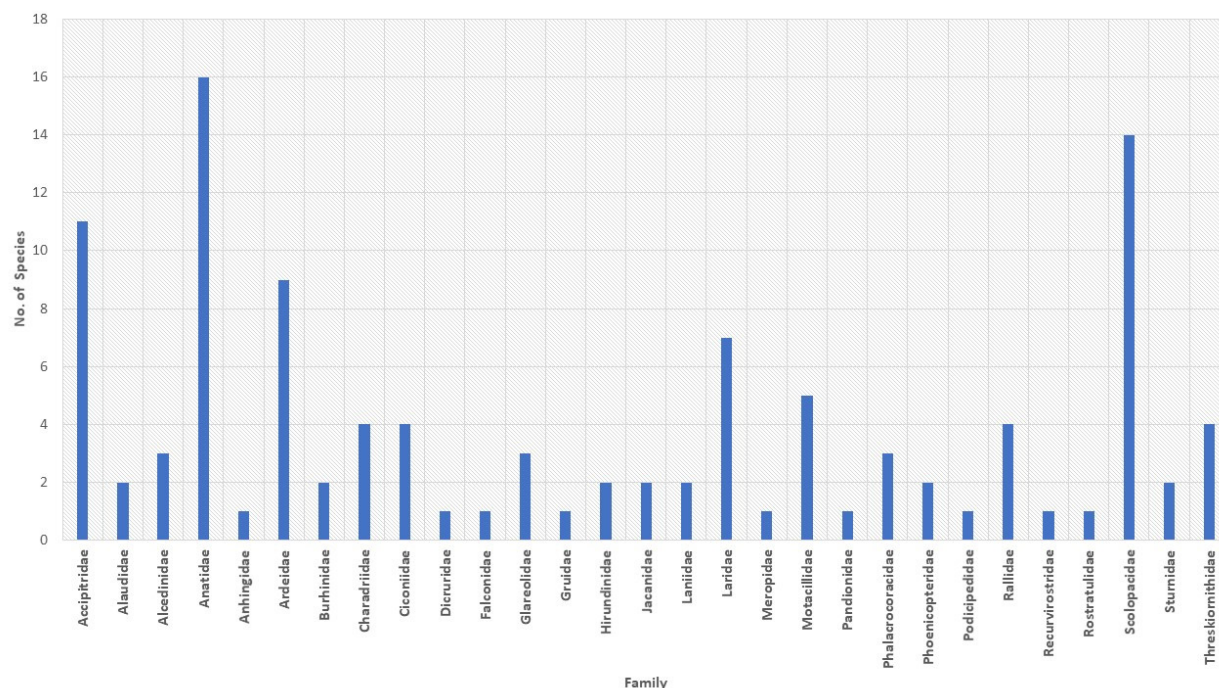


Figure 1. Distribution of bird species across families.

Common Pochard *Aythya farina* and Greater Spotted Eagle *Clanga clanga* were found to belong to the Vulnerable category of the IUCN and their number is found to be decreasing globally; while Eurasian Curlew *Numenius arquata*, Oriental Darter *Anhinga melanogaster*, Black-tailed Godwit *Limosa limosa*, Black-headed Ibis *Threskiornis melanocephalus*, Lesser Flamingo *Phoeniconaias minor*, Painted Stork *Mycteria leucocephala*, River Tern *Sterna aurantia*, and Great Thick-knee *Esacus recurvirostris* represent the Near Threatened (NT) category of IUCN Red List.

Feeding class-wise distribution of observed species indicated that mudflat feeders were most common with 23% species, followed by upland feeders with 16%, marsh feeders with 14%, bird of prey with 12%, surface feeders and fish eaters each with 11%, while divers and wet meadow feeders were represented with 8.5% and 5% of the species, respectively (Figure 2).

Relative abundance analysis indicates Common Coot *Fulica atra* as most abundant at Kumbhargoan (Ujjani) and Palasdev while Oriental Darter *Anhinga melanogaster* and Eurasian Curlew *Numenius arquata* were least abundant. The Painted Stork *Mycteria leucocephala* and Rosy Starling *Pastor roseus* were found to be most abundant at Bhadalwadi wetland and Eurasian Curlew *Numenius arquata*, Pheasant-tailed Jacana *Hydrophasianus chirurgus* were least abundant. At Madanwadi wetland Common Sandpiper

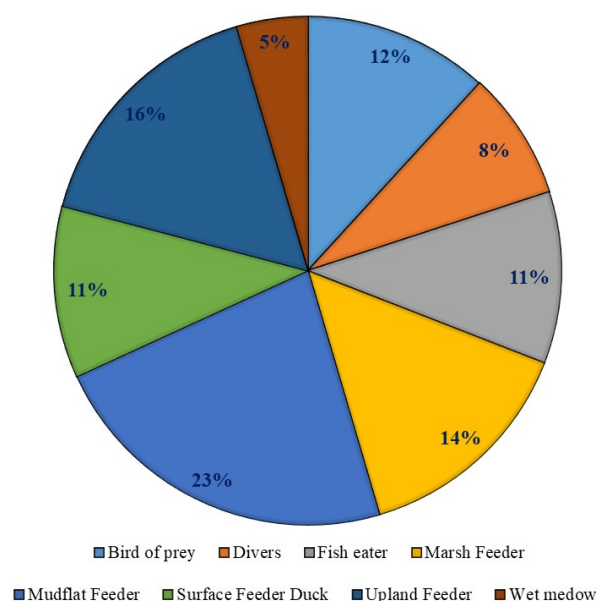


Figure 2. Representation of species (%) across feeding habitat class.

Actitis hypoleucos, Little Ringed Plover *Charadrius dubius* showed highest relative abundance and Eurasian Thick-knee *Burhinus oedicephalus*, Great Cormorant *Phalacrocorax carbo* recorded the lowest. The Common Coot *Fulica atra* and Brahminy Starling *Sturnia pagodarum* were found to be most abundant at Pimple and Ravangaon wetland respectively while Great Egret *Ardea alba* and Common Moorhen *Gallinula chloropus*

Table 1. Status of birds recorded at Ujjani and its satellite wetlands, Maharashtra.

	Family & Species	Wetland	Month	Resident status	Abundance	Red List Status
	Accipitridae					
1	Black-winged Kite <i>Elanus caeruleus</i>	Uj, Bh, Ma, Pa, Ra	Jan–Dec	R	F	LC
2	Black Kite <i>Milvus migrans</i>	Uj, Bh, Ma, Pa, Pi, Ra	Jan–Dec	R	F	LC
3	Brahminy Kite <i>Haliastur indus</i>	Uj, Bh, Ma, Pa, Pi, Ra	Jan–Dec	R	C	LC
4	Greater Spotted Eagle <i>Clanga clanga</i>	Uj	Feb	M	O	VU
5	Crested Serpent Eagle <i>Spilornis cheela</i>	Uj, Bh, Pa, Ra	Jan–Dec	R	F	LC
6	Western Marsh Harrier <i>Circus aeruginosus</i>	Uj, Bh, Pa	Dec–Feb	M	F	LC
7	Montagu's Harrier <i>Circus pygargus</i>	Uj, Pa	Dec–Feb	M	R	LC
8	Bonelli's Eagle <i>Aquila fasciata</i>	Uj, Ra	Nov–Feb	R	O	LC
9	Tawny Eagle <i>Aquila rapax</i>	Uj, Ma, Ra	Jan–Dec	R	O	LC
10	Short-toed Snake Eagle <i>Circaetus gallicus</i>	Uj, Bh, Pa, Ra	Jan–Dec	R	O	LC
11	Shikra <i>Accipiter badius</i>	Uj, Pa	Sep–Dec	R	O	LC
	Alaudidae					
12	Indian Bushlark <i>Mirafra erythroptera</i>	Uj, Ma, Pa, Ra	Jan–Dec	R	C	LC
13	Rufous-tailed Lark <i>Ammomanes phoenicura</i>	Uj, Ma	Jan–Dec	R	F	LC
	Alcedinidae					
14	Common Kingfisher <i>Alcedo atthis</i>	Uj, Bh, Ma, Pa, Pi, Ra	Jan–Dec	R	C	LC
15	Pied Kingfisher <i>Ceryle rudis</i>	Uj, Bh, Pa	Jan–Dec	R	F	LC
16	White-throated Kingfisher <i>Halcyon smyrnensis</i>	Uj, Bh, Ma, Pa, Pi, Ra	Jan–Dec	R	F	LC
	Anatidae					
17	Indian Spot-billed Duck <i>Anas poecilorhyncha</i>	Uj, Bh, Ma, Pa, Pi, Ra	Jan–Dec	R	C	LC
18	Comb Duck <i>Sarkidiornis melanotos</i>	Uj, Pa	Oct–Mar	R	R	LC
19	Lesser Whistling Duck <i>Dendrocygna javanica</i>	Uj, Bh, Pa	Jan–Dec	R	C	LC
20	Tufted Duck <i>Aythya fuligula</i>	Uj, Bh, Pa	Nov–Feb	M	O	LC
21	Eurasian Wigeon <i>Mareca penelope</i>	Uj, Bh, Pa	Nov–Mar	M	O	LC
22	Gadwall <i>Mareca strepera</i>	Uj, Bh, Pa	Nov–Feb	M	F	LC
23	Garganey <i>Spatula querquedula</i>	Uj, Bh, Ma, Pa, Pi, Ra	Oct–Mar	R	F	LC
24	Bar-headed Goose <i>Anser indicus</i>	Uj, Pa	Nov–Mar	M	F	LC
25	Cotton Teal <i>Nettapus coromandelianus</i>	Uj, Bh, Ma, Pa	Oct–Jan	R	O	LC
26	Northern Pintail <i>Anas acuta</i>	Uj, Bh, Pa	Nov–Feb	M	F	LC
27	Northern Shoveler <i>Spatula clypeata</i>	Uj, Bh, Pa	Nov–Mar	M	O	LC
28	Common Pochard <i>Aythya ferina</i>	Uj, Bh, Pa	Jan–Feb	M	R	VU
29	Red-crested Pochard <i>Netta rufina</i>	Uj, Pa	Jan–Feb	M	R	LC
30	Ruddy Shelduck <i>Tadorna ferruginea</i>	Uj, Bh, Ma, Pa	Nov–Mar	M	F	LC
31	Common Teal <i>Anas crecca</i>	Uj, Bh, Pa, Pi	Nov–Feb	R	F	LC
32	Common Shelduck <i>Tadorna tadorna</i>	Uj, Bh, Ma, Pa	Dec–Jan	M	R	LC
	Anhingidae					
33	Oriental Darter <i>Anhinga melanogaster</i>	Uj, Bh, Ma, Pa	Oct–Feb	R	R	NT
	Ardeidae					
34	Cattle Egret <i>Bubulcus ibis</i>	Uj, Bh, Ma, Pa, Pi, Ra	Jan–Dec	R	C	LC
35	Great Egret <i>Ardea alba</i>	Uj, Bh, Ma, Pa, Pi, Ra	Jan–Dec	R	C	LC
36	Intermediate Egret <i>Ardea intermedia</i>	Uj, Bh, Ma, Pa	Jan–Dec	R	F	LC
37	Little Egret <i>Egretta garzetta</i>	Uj, Bh, Ma, Pa, Pi	Jan–Dec	R	C	LC

	Family & Species	Wetland	Month	Resident status	Abundance	Red List Status
38	Black-crowned Night Heron <i>Nycticorax nycticorax</i>	Uj, Bh, Ma, Pa	Jan–Dec	R	O	LC
39	Grey Heron <i>Ardea cinerea</i>	Uj, Bh, Ma, Pa, Pi, Ra	Oct–May	R	C	LC
40	Indian Pond Heron <i>Ardeola grayii</i>	Uj, Bh, Ma, Pa, Pi, Ra	Jan–Dec	R	C	LC
41	Striated Heron <i>Butorides striata</i>	Uj, Bh, Ma, Pa, Pi	Jan–Dec	R	F	LC
42	Purple Heron <i>Ardea purpurea</i>	Uj, Bh, Ma, Pa	Jan–Dec	R	F	LC
	Burhinidae					
43	Eurasian Thick-knee <i>Burhinus oedicnemus</i>	Uj, Ma, Pa, Pi	Jan–Dec	R	O	LC
44	Great Thick-knee <i>Esacus recurvirostris</i>	Uj, Bh, Pa	Jan–Dec	R	R	NT
	Charadriidae					
45	Red-wattled Lapwing <i>Vanellus indicus</i>	Uj, Bh, Ma, Pa, Pi, Ra	Jan–Dec	R	F	LC
46	Yellow-wattled Lapwing <i>Vanellus malabaricus</i>	Uj, Ma, Pa	Jan–Dec	R	O	LC
47	Kentish Plover <i>Charadrius alexandrinus</i>	Uj, Ma	Nov–Feb	R	O	LC
48	Little Ringed Plover <i>Charadrius dubius</i>	Uj, Ma, Pa, Pi	Jan–Dec	R	A	LC
	Ciconiidae					
49	Asian Openbill <i>Anastomus oscitans</i>	Uj, Bh, Pa	Jan–Dec	R	F	LC
50	Painted Stork <i>Mycteria leucocephala</i>	Uj, Bh, Pa	Jan–Dec	R	C	NT
51	European White Stork <i>Ciconia ciconia</i>	Uj, Pa	Nov–Jan	R	F	LC
52	Woolly-necked Stork <i>Ciconia episcopus</i>	Uj, Bh, Ma, Pa	Oct–Dec	R	O	VU
	Dicruridae					
53	Black Drongo <i>Dicrurus macrocercus</i>	Uj, Bh, Ma, Pa, Pi, Ra	Jan–Dec	R	C	LC
	Falconidae					
54	Common Kestrel <i>Falco tinnunculus</i>	Uj, Pa, Ra	Nov–Feb	M	C	LC
	Glareolidae					
55	Collared Pratincole <i>Glareola pratincola</i>	Uj, Ma	Oct–May	M	F	LC
56	Oriental Pratincole <i>Glareola maldivarum</i>	Uj, Ma	Oct–May	M	F	LC
57	Little Pratincole <i>Glareola lactea</i>	Uj, Ma, Pa	Jan–Dec	R	A	LC
	Gruidae					
58	Demoiselle Crane <i>Grus virgo</i>	Uj	Jan	M	O	LC
	Hirundinidae					
59	Barn Swallow <i>Hirundo rustica</i>	Uj, Bh, Ma, Pa, Pi, Ra	Oct–Jan	M	C	LC
60	Wire-tailed Swallow <i>Hirundo smithii</i>	Uj, Bh, Ma, Pa, Pi, Ra	Oct–Jan	M	F	LC
	Jacanidae					
61	Bronze-winged Jacana <i>Metopidius indicus</i>	Uj, Bh	Jul	R	R	LC
62	Pheasant-tailed Jacana <i>Hydrophasianus chirurgus</i>	Uj, Bh	Aug	R	R	LC
	Laniidae					
63	Bay-backed Shrike <i>Lanius vittatus</i>	Uj, Bh, Ma, Pa, Pi	Jan–Dec	R	C	LC
64	Long-tailed Shrike <i>Lanius schach</i>	Uj, Pa, Ra	Jan–Dec	R	C	LC
	Laridae					
65	Black-headed Gull <i>Chroicocephalus ridibundus</i>	Uj, Pa	Nov–Feb	M	F	LC
66	Brown-headed Gull <i>Chroicocephalus brunnicephalus</i>	Uj, Pa	Nov–Feb	M	F	LC
67	Pallas's Gull <i>Ichthyophaga ichthyophaga</i>	Uj, Pa	Dec–Jan	M	O	LC
68	Caspian Tern <i>Hydroprogne caspia</i>	Uj, Pa	Dec–Mar	M	F	LC
69	Gull-billed Tern <i>Gelochelidon nilotica</i>	Uj, Pa	Dec–Mar	M	F	LC
70	River Tern <i>Sterna aurantia</i>	Uj, Pa	Dec–Mar	M	F	NT

	Family & Species	Wetland	Month	Resident status	Abundance	Red List Status
71	Whiskered Tern <i>Chlidonias hybrida</i>	Uj, Pa	Jan–Mar	R	F	LC
	Meropidae					
72	Green Bee-eater, <i>Merops orientalis</i>	Uj, Bh, Pa, Pi, Ra	Jan–Dec	R	C	LC
	Motacillidae					
73	Citrine Wagtail <i>Motacilla citreola</i>	Uj, Ma,	Nov–Feb	M	F	LC
74	Grey Wagtail <i>Motacilla cinerea</i>	Uj, Ma, Pa	Nov–Feb	M	C	LC
75	White-browed Wagtail <i>Motacilla maderaspatensis</i>	Uj, Ma, Ra	Jan–Dec	R	F	LC
76	Western Yellow Wagtail <i>Motacilla flava</i>	Uj, Pa	Nov–Feb	M	C	LC
77	White Wagtail <i>Motacilla alba</i>	Uj	Jan–Feb	M	F	LC
	Pandionidae					
78	Osprey <i>Pandion haliaetus</i>	Uj, Pa	Dec–Feb	M	O	LC
	Phalacrocoracidae					
79	Great Cormorant <i>Phalacrocorax carbo</i>	Uj, Bh, Ma, Pa,	Oct–Jan	R	F	LC
80	Indian Cormorant <i>Phalacrocorax fuscicollis</i>	Uj, Bh, Ma, Pa, Pi, Ra	Jan–Dec	R	A	LC
81	Little Cormorant <i>Microcarbo niger</i>	Uj, Bh, Ma, Pa, Pi, Ra	Jan–Dec	R	A	LC
82	Greater Flamingo <i>Phoenicopterus roseus</i>	Uj, Pa	Jan–Feb	M	O	LC
83	Lesser Flamingo <i>Phoeniconaias minor</i>	Uj, Pa	Feb–Mar	M	R	NT
	Podicipedidae					
84	Little Grebe <i>Tachybaptus ruficollis</i>	Uj, Bh, Ma, Pa, Pi	Jan–Dec	R	A	LC
	Rallidae					
85	Common Coot <i>Fulica atra</i>	Uj, Bh, Pa, Pi	Jan–Dec	R	A	LC
86	Common Moorhen <i>Gallinula chloropus</i>	Uj, Bh, Ma, Pa, Pi	Jul–Oct	R	F	LC
87	Purple Swampphen <i>Porphyrio porphyrio</i>	Uj, Bh, Ma, Pa, Pi	Jan–Dec	R	F	LC
88	White-breasted Waterhen <i>Amaurornis phoenicurus</i>	Uj, Bh, Ma, Pa, Pi	Jul–Oct	R	F	LC
	Recurvirostridae					
89	Black-winged Stilt <i>Himantopus himantopus</i>	Uj, Ma, Pa, Ra	Jan–Dec	R	C	LC
	Rostratulidae					
90	Greater Painted-snipe <i>Rostratula benghalensis</i>	Uj, Pa	Jan–Dec	R	O	LC
	Scolopacidae					
91	Eurasian Curlew <i>Numenius arquata</i>	Uj, Bh	Nov–Mar	R	R	NT
92	Black-tailed Godwit <i>Limosa limosa</i>	Uj, Pa	Nov–Feb	M	F	NT
93	Common Greenshank <i>Tringa nebularia</i>	Uj, Ma, Pa	Nov–Mar	M	F	LC
94	Common Redshank <i>Tringa totanus</i>	Uj, Ma, Pa	Oct–Mar	R	F	LC
95	Spotted Redshank <i>Tringa erythropus</i>	Uj, Pa	Oct–Par	R	O	LC
96	Ruff <i>Calidris pugnax</i>	Uj, Pa	Nov–Dec	R	R	LC
97	Common Sandpiper <i>Actitis hypoleucos</i>	Uj, Ma, Pa	Nov–May	M	F	LC
98	Green Sandpiper <i>Tringa ochropus</i>	Uj, Pa	Nov–May	M	F	LC
99	Marsh Sandpiper <i>Tringa stagnatilis</i>	Uj, Pa	Nov–Jan	M	O	LC
100	Wood Sandpiper <i>Tringa glareola</i>	Uj, Pa	Jan–Apr	M	O	LC
101	Common Snipe <i>Gallinago gallinago</i>	Uj, Bh, Ma, Pa	Nov–Feb	M	F	LC
102	Pintail Snipe <i>Gallinago stenura</i>	Uj, Pa	Nov–Feb	M	O	LC
103	Little Stint <i>Calidris minuta</i>	Uj, Ma, Pa, Pi	Oct–Mar	M	F	LC
104	Temminck's Stint <i>Calidris temminckii</i>	Uj, Bh	Jan–Feb	M	O	LC

	Family & Species	Wetland	Month	Resident status	Abundance	Red List Status
	Sturnidae					
105	Rosy Starling <i>Pastor roseus</i>	Uj, Bh, Pa	Dec–Feb	M	F	LC
106	Brahminy Starling <i>Sturnia pagodarum</i>	Uj, Ma, Pa, Ra	Jan–Dec	R	C	LC
	Threskiornithidae					
107	Black-headed Ibis <i>Threskiornis melanocephalus</i>	Uj, Bh, Ma, Pa	Sep–Oct	R	F	NT
108	Glossy Ibis <i>Plegadis falcinellus</i>	Uj, Bh, Ma, Pa	Oct–Jan	M	O	LC
109	Indian Black Ibis <i>Pseudibis papillosa</i>	Uj, Bh, Ma, Pa, Pi	Jan–Dec	R	F	LC
110	Eurasian Spoonbill <i>Platalea leucorodia</i>	Uj, Bh, Pa	Jan–Dec	R	F	LC

Uj—Ujjani | Bh—Bhadalwadi | Ma—Madanwadi | Pa—Palasdev | Pi—Pimple | Ra—Ravangaon | R—Resident | M—Migratory | LC—Least Concerned | NT—Near Threatened | VU—Vulnerable | A—Abundant | C—Common | F—Frequent | O—Occasional | R—Rare.

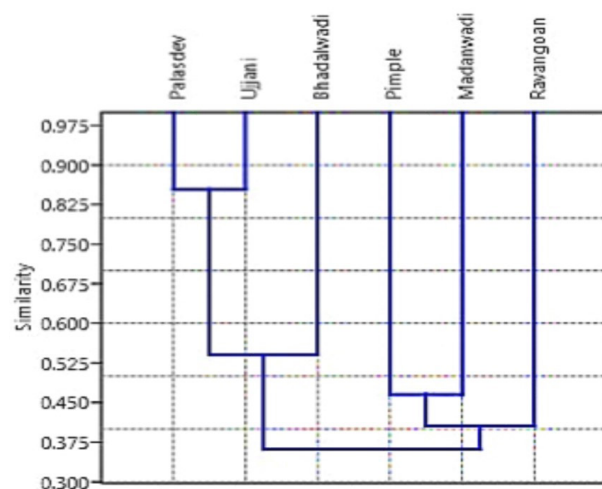


Figure 3. Similarity between satellite wetlands and Ujjani. Comparison was made using Jaccard's similarity index (Paired group-UPGMA).

were found to be least abundant.

When Shannon-Weiner diversity and evenness across satellite wetlands were calculated, it was found to be 3.5, 0.37 at Kumbhargao (Ujjani) followed by 3.5, 0.38 at Palasdev; 3.1, 0.42 at Madanwadi, 2.6, 0.45 at Pimple, 2.5, 0.22 at Bhadalwadi, and 2.2, 0.33 Ravangaon wetland at $p < 0.05$.

Jaccard's similarity index was calculated from the record of occurrence of the bird species across these wetlands. It was observed that, Kumbhargao (Ujjani) and Palasdev were most similar wetlands with index value of 0.88, while Kumbhargao (Ujjani) and Ravangaon were most dissimilar in their species composition with index value of 0.36. Kumbhargao (Ujjani) and Bhadalwadi was more similar with index value of 0.59 followed by Kumbhargao (Ujjani) and Madanwadi with reported value of 0.49. Kumbhargao (Ujjani) and Pimple to were

among least similar wetlands with value of 0.4. It reveals that, out of five associated wetlands of Ujjani reservoir; Palasdev, Bhadalwadi and Madanwadi wetlands show high resemblance and similarity for the inhabitation of wetland bird communities. Bird communities harboured by Ujjani and Ravangaon wetland were fairly distinct. Detailed cluster analysis paired (UPGMA) of Jaccard's similarity Index of each wetland was shown in Figure 3.

Present study provides checklist of wetland bird communities at Ujjani as well as its five satellite wetlands. Of the 110 bird species recorded at Kumbhargao (Ujjani) wetland, 94 were recorded at Palasdev, while 59, 54, 31, and 29 species were reported at Bhadalwadi, Madanwadi, Pimple, and Ravangaon wetlands, respectively. Vital base line information on the presence and abundance of bird communities based on sightings were collected. Ujjani and other wetlands have shallow water expanse resulting in rich abundance and diversity of bird communities. The wetland bird communities are in general heterogeneous in their feeding habitat (Kumar & Gupta 2013). The diversity of the wetland birds observed at other satellite wetlands may indicate a presence of a wide spectrum of feeding niches. In the present study agriculture fields surrounding the Kumbhargao (Ujjani) wetland and satellite wetlands with scattered plants, viz., *Acacia* species, *Zizyphus* species, and *Tamarindus* species, probably provide diverse roosting and foraging habitation grounds to the bird communities.

A comparison of bird communities of main wetlands with its satellite wetlands revealed that, some of the satellite wetlands support an almost equal number of bird species to that of the main wetland. Also, all these satellite wetlands together share, more than 95% of the total bird species composition of Ujjani wetland. Presence of the threatened bird species highlights the significance of the wetland as an important

conservation site (Islam & Rahmani 2004, 2008) and wintering ground for wetland birds. From conservation priorities both large as well as small wetlands are important. Reduction in existing anthropogenic activities like cattle grazing, fishing, sand and soil mining, land encroachment, urban development, and tourism would improve conservation status of bird communities. Detailed studies on physical characterization of wetlands and habitat preference by bird communities are necessary to understand the role of satellite wetlands in the conservation of avifauna.

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